IRI Multi-Model Ensemble Activities

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Outline

1. 2-Tier MME
   a. Current System (Distributed)
   b. Historical Skill
   c. New Tools for Users
   d. Research: CTB

2. 1-Tier MME
   a. Current System
   b. Bayesian versus Pooling with short data record

3. Use of Forecast Information in sectoral applications in developing world

4. Future directions

5. More details if time permits
IRI’s 2-Tiered Climate Forecasting System in 2010
IRI 2-Tier Forecast Methodology

- Atmospheric GCMs forced with forecast SST scenarios
  - Mean of CFS, CA and LDEO
  - Positive and negative perturbations based on historical error
- Pattern-based correction of individual model ensemble means.
  - Regression based on historical model runs
    - Forecast SST (CA)
    - Observed SST
  - Spread estimate from historical forecasts with forecast SST.
- Equal weighting of corrected models
- Forecast probabilities
  - Gaussian distribution for temperature
  - Transformed Gaussian for precipitation
Method of Forming 3 SST Predictions for Climate Predictions

For each ocean basin, the 3 SST scenarios are (1) mean of the models used for that basin, (2) mean +p and (3) mean -p. p is uncertainty factor from 1st EOF of model historical error.
IRI DYNAMICAL CLIMATE FORECAST SYSTEM

2-tiered

OCEAN

ATMOSPHERE

FORECAST SST

TROP. PACIFIC:
(multi-models, dynamical and statistical)

TROP. ATL, INDIAN:
(multi-models, dynamical and statistical)

EXTRATROPICAL:
damped persistence

PERSISTED
GLOBAL
SST
ANOMALY

GLOBAL ATMOSPHERIC MODELS

- ECPC(Scripps)
- ECHAM4.5(MPI)
- CCM3.6(NCAR)
- GFDL
- GMAO(NASA)
- COLA2

Persisted SST Ensembles
3 Mo. lead

Forecast SST Ensembles
3/6 Mo. lead

POST PROCESSING
MULTIMODEL ENSEMBLING

IRI DYNAMICAL CLIMATE FORECAST SYSTEM
Reliability Diagram – IRI Precipitation Forecasts

(a) Global Precipitation

(b) Tropical Precipitation

- Above normal
- Near normal
- Below normal
Reliability Diagram – IRI Temperature Forecasts

(c) Global Temperature

(d) Tropical Temperature

Observed Relative Frequency

Forecast Relative Frequency

Forecast Probability

Above normal
Near normal
Below normal
Flexible format map room

Forecast issued: May 2002
Target Season: JAS

Probability of Exceedance

Longitude 122.5W Latitude 40N lead 3.5 months start 0000 1 May
CTB supported work

• “Recalibrating and combining ensemble predictions”
  – Pattern-based correction of model output
    • Are regression forecasts reliable?
    • How are patterns selected?
  – Information beyond terciles
  – Results being incorporated into IRI Net Assessment methodology

• “Incorporating scale and predictability information in multimodel ensemble climate predictions”
  – Using spatial and predictability information in the calculation of multimodel weights
Coupled MME Forecast System
1-Tier Experimental Multi-Model Ensemble

Models:

- ECHAM-DC2
- ECHAM-AC1
- ECHAM-GML
- NCEP-CFS

Hindcasts from 1982 to present.

Simple pooling MME. Found to be (slightly) superior to Bayesian combination. But still exploring other combination schemes.

Forecasts are available on the web.

Forecast over US is CPC forecast.

Next step is to combine with 2-tier forecasts.
Skill Comparison: Bayesian Versus Pooling
Use of Seasonal Forecasts in Sectoral Application
Global versus Local Optimization

IRI produces a variety of sectorally based seasonal forecast products.

Inputs can come from globally optimized solutions (Global MME) or locally optimized solutions (examples shown).

Sectoral collaborators will pick the solution that works best for them. One size does not fit all.**

Possible for IRI to leverage US National MME products as additional tools for sectoral scientists to choose from.
IRI MME Future Directions

1. Explore combined MME with 2-tier and 1-tier models.
2. Climate Test Bed projects.
3. Continue Development of “Locally Optimized” MMEs in regionally specific sectoral contexts which use local observed data for MOS correction and downscaling.
4. Work with others to help develop National MME and apply these models in applications contexts.
   a. MOS correction.
   b. Model weighting.
   c. User tools including retrospective skill evaluation.
CSIR Downscaled Streamflow Forecast for South Africa (Local Optimization) Willem Landman
Intercomparison of GCM precipitation seasonal forecast skill
Anomaly correlation

June–Sept
Seasonal total
from May 1
(1982–08)
2009 MME Precip Real-Time Forecasts for India
Made by ERFS project at IIT-Delhi

Categorical MME [(Jun-Sep)2009(Jun)] using following models
ECHAM4p5-GML, ECHAM4p5-CA, ECHAM405-MOM3, CFS, JAMSTEC

JJAS(Jun 1)

JAS (Jul 1)

Obs-JJAS

5 GCMS: CFS, JAMSTEC, ECHAM4.5-caSST, ECHAM4.5-GML, ECHAM4.5-MOM3
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**IRI Seasonal Temperature Flexible Forecast**

- **Forecast issued:** May 2002
- **Target Season:** JJA, JAS, ASO, SON
- **Probability of exceedance**
- **Climatology:** 1970, 1999
- **Percentile threshold:** 50%

Map showing temperature forecast with color-coded regions and numerical values indicating temperature predictions.